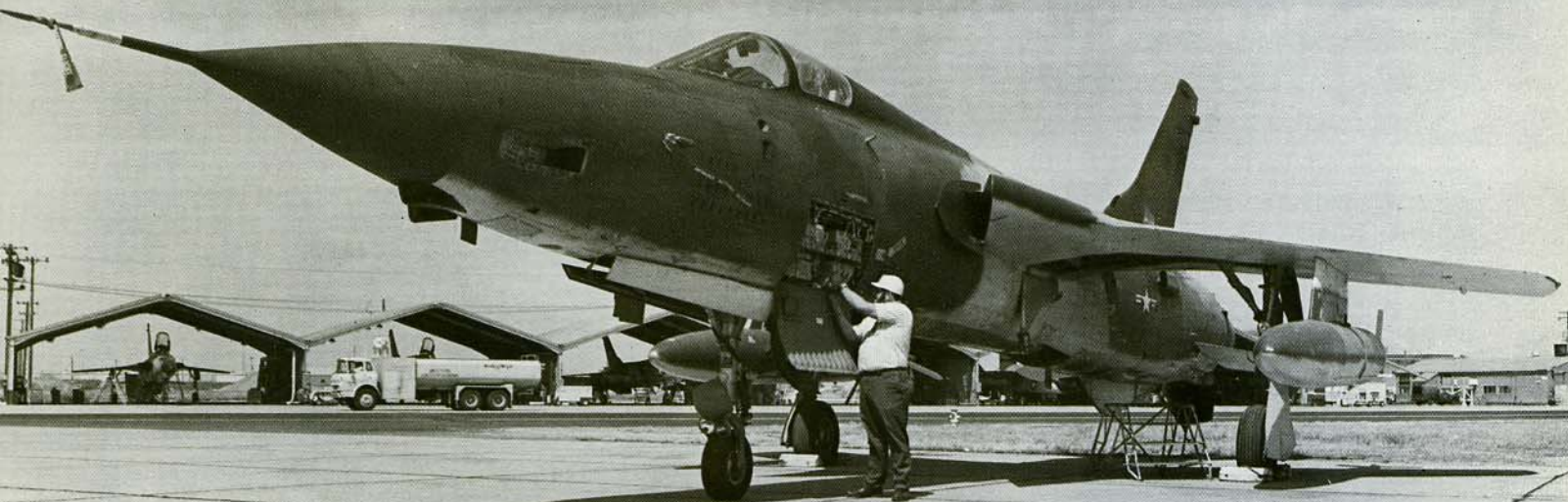


APPLICATIONS OF COMPUTERIZED AUTOMATIC TEST SYSTEMS

Depot testing of avionic modules

A Testing Problem Solved for: USAF
Hill Air Force Base
Ogden, Utah



Autopilot assemblies are removed in the field and sent to Hill AFB for repair. Here a technician is shown removing an autopilot from an F-105 at McClellan AFB, Sacramento, California.



Depot testing of avionics modules . . .

Hill AFB is a major maintenance depot for the United States Air Force. Among its many responsibilities is maintenance of avionics modules for the F-105 Thunderchief, F-4C Phantom, and many other aircraft.

A specific testing problem facing Hill was testing of FC-5 Autopilots used in the F-105 Thunderchief fighter/bomber. The FC-5 Autopilot was undergoing an update modification (Thunderstick II) which would have required major changes to the punched tape-controlled systems then used for testing these autopilots. Down-time for the testers was also a problem, because of the large number of electromechanical components they contained. Hill AFB was therefore interested in new automatic test equipment which would solve the existing testing problem, *and* be readily adaptable to many other testing requirements.

Computer-Controlled Testing

The HP 9500 series Automatic Test System supplied to Hill AFB was intended initially to test the updated FC-5 Autopilots. In this application, the system tests individually the four amplifier modules comprising the FC-5 Autopilot. The module is placed in an "L-frame" adapter; interconnections between the adapter and the system are made through a passive interface box (furnished by Hill).

The test program for an amplifier module, contained on a small roll of punched tape, is read into the computer memory in a few seconds through the high-speed tape reader. The operator then commands the test to begin, and the system proceeds automatically, applying the proper stimulus conditions and measuring the amplifier responses. At the conclusion of the test, the system prints out a test report listing the test steps failed by the module and the actual responses measured for the failed test steps. The operator then fills in the module serial number and test date, and sends the completed test report along with the module to the repair group. Here the repair technician compares the failed tests against his reference T.O. (Technical Order) and quickly locates the faults.

The test procedure for some modules requires adjustments to be made by the operator on the module during the course of the test. In these cases the system prints out instructions to the operator when it reaches these adjustment points in the test program.

The system can also be programmed to test itself, and the system self-check program is usually run at the beginning of each shift.

Faster Testing through Computer Control

In testing the FC-5 Autopilot amplifier modules, the system performs between 200 and 300 tests in 4 to 5 minutes (depending on the module type being tested). A complete autopilot (four amplifier modules) representing about 900 tests is tested in about 25 minutes.

By comparison, the tape-controlled testers took about an hour per module, for an overall test time of 3½ to 4½ hours for a complete autopilot. Hill thus found the computer-controlled system ten times faster than the existing method. Naturally, the improvement over manual testing would have been even more dramatic.

Programming by Test Technicians

The system is programmed in HP BASIC, a simple language close to everyday English. Each statement is checked by the computer as it is entered, so a syntactically correct program can be developed quickly while sitting at the teletypewriter. Factory training for Hill's technicians included approximately one day on the use of the language. Hill's first programs, for the FC-5 Autopilot, were in the order of 500 statements long, and took them between 1 and 2 weeks to write, plus a week to debug the program for testing validity. With experience, Hill's technicians are now able to write programs of similar complexity in 3 to 5 days. Program modifications to handle design changes (DCN's) are accomplished in hours.

Adaptability to Different Tasks

The HP test system's first assignment was checking performance of the modified FC-5 Autopilots, and it was initially used for this purpose on a two shifts/day basis, with the third shift reserved for program development. During this period one of the system operators wrote the test program for the ASN-46 Navigational Amplifier (part of

the navigational computer system for the F-4C Phantom II), and this was completed by the time they were ready to start testing these modules. Testing of the ASN-46 also brought into play the digital to synchro/resolver converter and synchro/resolver to digital converter (digital angle readout) which were not needed for the FC-5.

Subsequently, Hill technicians developed the test programs for the ASA-32 Autopilot for the F-4C (including the Servo Amplifier and Canceller Amplifier modules) and for the SA56 and M1132A1 modules of the F-4C navigational system. Hill is now investigating programming their system to accomplish final testing of the Horizontal Situation Indicator used on F-111, C-141, and C-5 aircraft. Should additional stimulus or measurement instruments be required for future test assignments, such hardware changes can be effected without major system modification.

Expanding the Program Storage Capability

Because they are now using their automatic test system to perform on-going testing of many different devices, Hill decided to add the auxiliary disc memory. This will add 750K words to the 16K words available in the computer memory. (The disc is a standard option that can be added on-site, at any time.) Hill will then store on the disc all module test programs in current use, retaining the punched tape 'originals' for permanent reference.

An On-Going Test Capability

The HP 9500 series test system was designed to be a long-term investment for Hill AFB. It solved their immediate test problem with a very substantial reduction in test times. It has allowed them to handle a variety of new test assignments, using *their own personnel* for programming, and therefore at a cost saving. And it can be expected to tackle new test problems in the future, at minimal additional cost. The intrinsic reliability of a test system using largely solid-state circuitry has been borne out in practice. System utilization has been excellent, with only occasional minor technical faults.

Typical test printout shows tests failed and instructions to operator.

SECTION 2: 'T'-STICK

S/N 6615-181-1960

P/N 853D778G2

W/O T3418C

DATE
15 APR 1970

SERIAL NO.
5413315

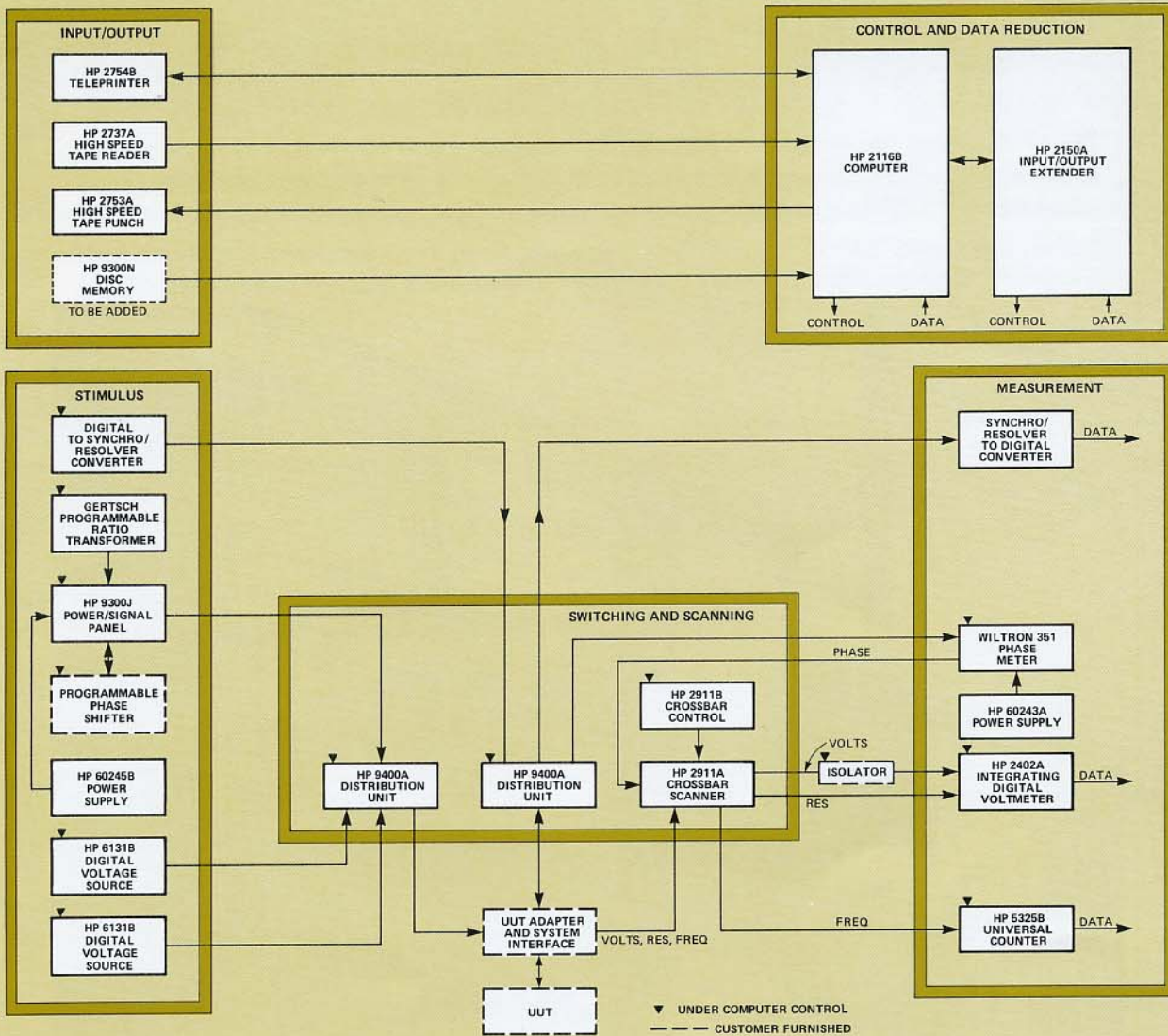
TIME DELAY RELAYS

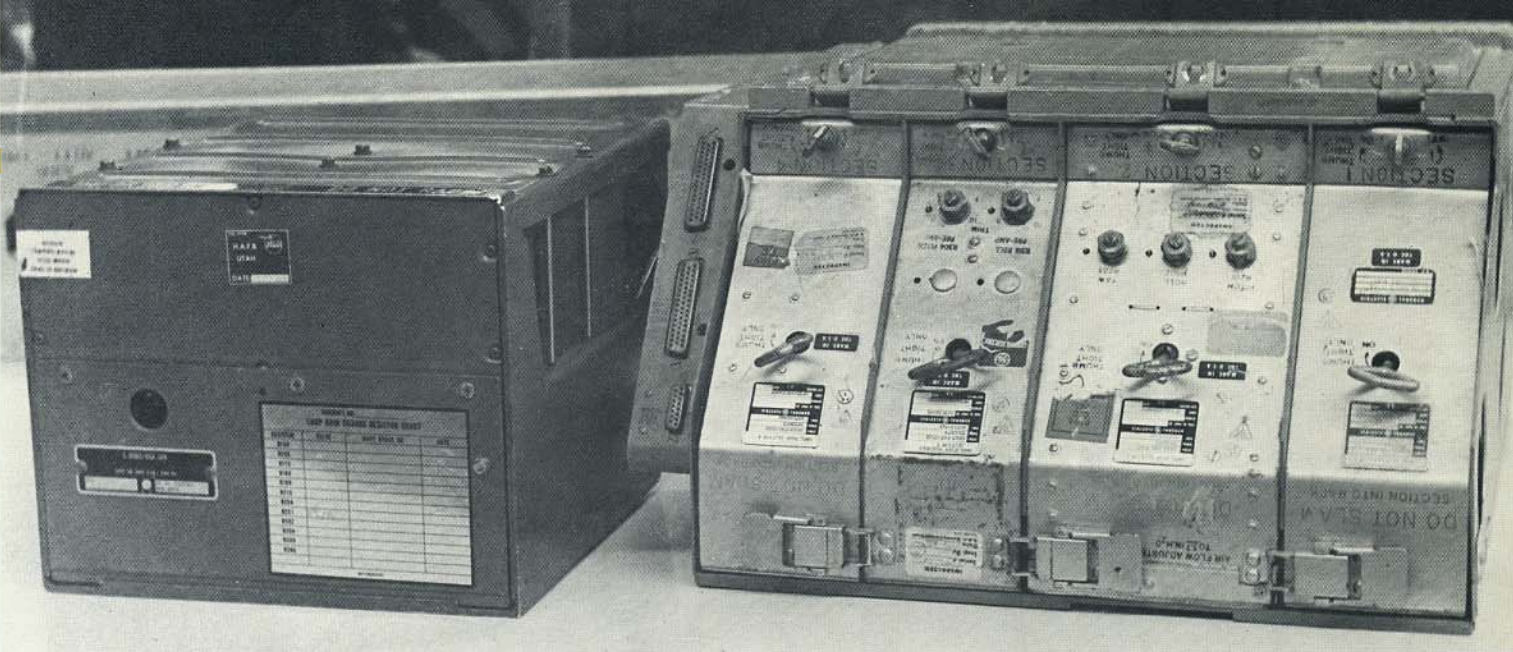
T/N	STATUS	TIME (SEC)
2	FAILURE	155.974
3	FAILURE	70.0142
4	FAILURE	70.241
5	FAILURE	70.0037
6	FAILURE	70.3857
7	FAILURE	72.995
8	FAILURE	72.9929
9	FAILURE	72.0256
10	FAILURE	72.4224
11	FAILURE	72.4125

T/N	DVM MEA (OHMS)	STATUS
1985	2998.1	FAILURE

T/N	DVM MEA (VOLTS)		STATUS
2000	27.700	VDC	FAILURE
2090	27.342	VDC	FAILURE
2095	27.726	VDC	FAILURE
2100	27.8	VDC	FAILURE
2110	27.765	VDC	FAILURE
2120	27.87	VDC	FAILURE
2130	28.206	VDC	FAILURE
2140	28.234	VDC	FAILURE
2180	28.204	VDC	FAILURE
2190	27.167	VDC	FAILURE
2200	27.756	VDC	FAILURE
2570	ADJUST R201 FULL CW & CCW THEN NULL		
2590	ADJUST R56 & R9, OR R201 TO 1.686+- .04 VAC 1.3254		

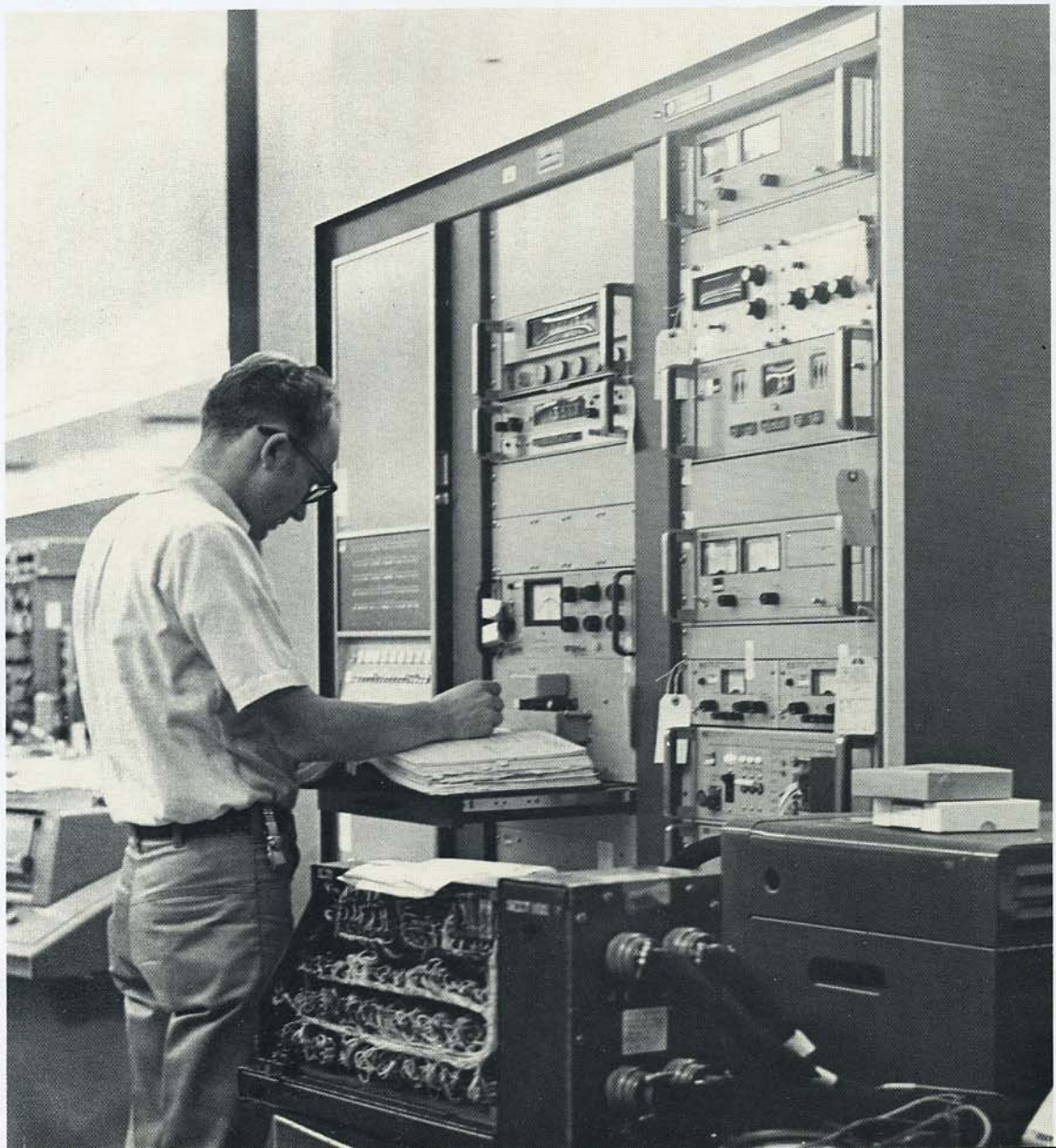
HP 9500 Series Automatic Test System, Hill AFB





The HP Automatic Test System tests both the FC-5 Autopilot (right) and the ASA-32 Autopilot (left) for the F-4C Phantom. The system is also capable of testing many other electronic assemblies.

The test technician studies his test procedure prior to developing a new test program for the automatic test system. Autopilot amplifier module (foreground) is connected to system through "L-frame".





For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181
West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva, Switzerland
